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Ishikida

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(54) **SEMICONDUCTOR PACKAGE, SEMICONDUCTOR DEVICE MANUFACTURING METHOD, AND SOLID-STATE IMAGING DEVICE**

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(52) **U.S. Cl.**
CPC ***H01L 27/14618*** (2013.01); *H01L 2224/48091* (2013.01); *H01L 2224/48227* (2013.01)

(58) **Field of Classification Search**
CPC H01L 27/14618; H01L 27/14636; H01L 23/06; H01L 23/492
USPC 257/432, 777, E21.499; 438/107, 116, 438/121
See application file for complete search history.

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(57) **ABSTRACT**

A semiconductor package includes: a sheet-like thin plate on which a semiconductor chip is secured; and a substrate including a wiring layer, disposed on the thin plate to extend over a part of a region surrounding the region where the semiconductor chip is secured or over the entire surrounding region, wherein the semiconductor chip and the substrate are electrically connected.

12 Claims, 3 Drawing Sheets

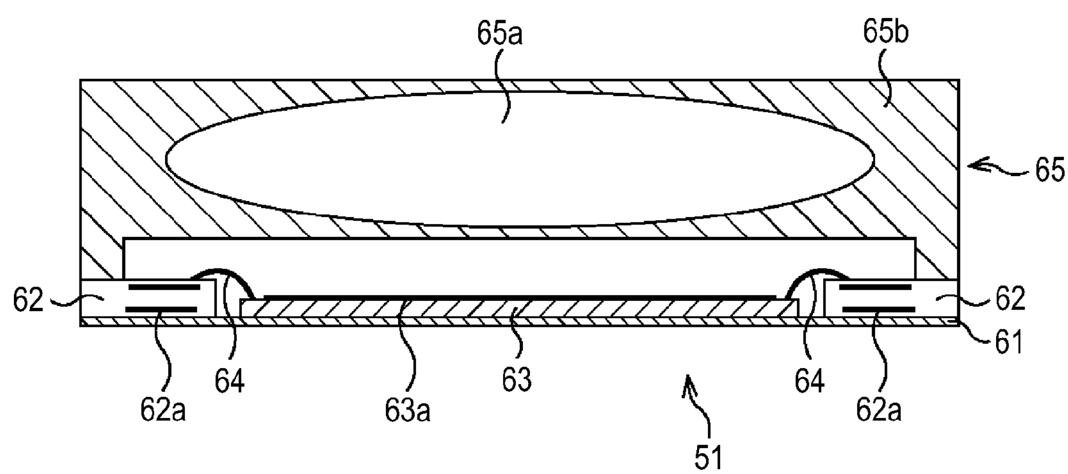
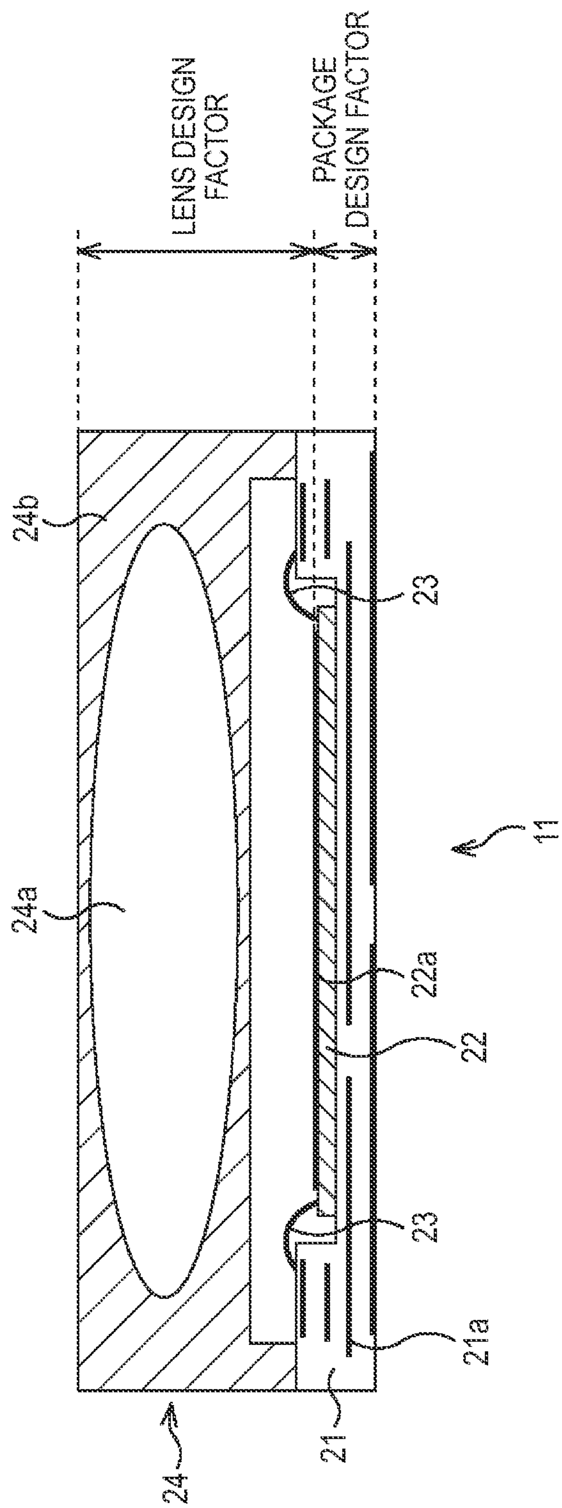


FIG. 1



PRIOR ART

FIG.2

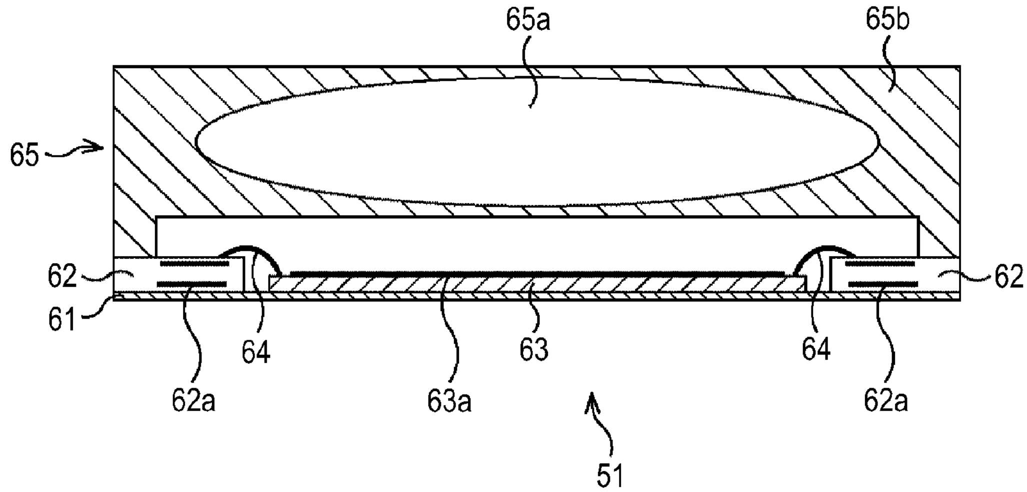

65a
65b
65
62
62
61
64
63
64
62a
63a
62a
51

FIG.3

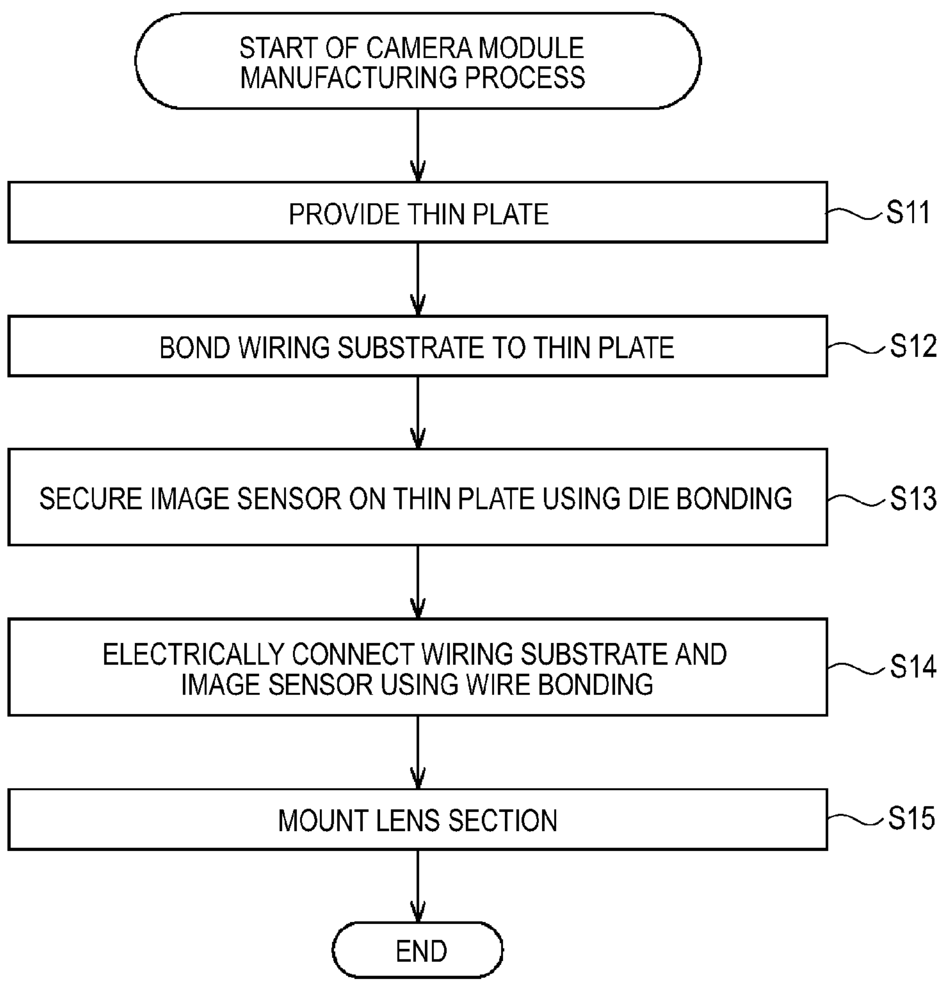

START OF CAMERA MODULE MANUFACTURING PROCESS
PROVIDE THIN PLATE
S11
BOND WIRING SUBSTRATE TO THIN PLATE
S12
SECURE IMAGE SENSOR ON THIN PLATE USING DIE BONDING
S13
ELECTRICALLY CONNECT WIRING SUBSTRATE AND IMAGE SENSOR USING WIRE BONDING
S14
MOUNT LENS SECTION
S15
END

FIG.4A

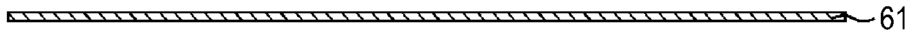


FIG.4B

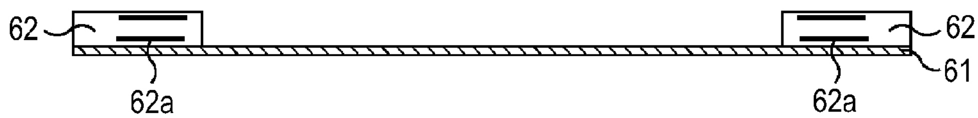


FIG.4C

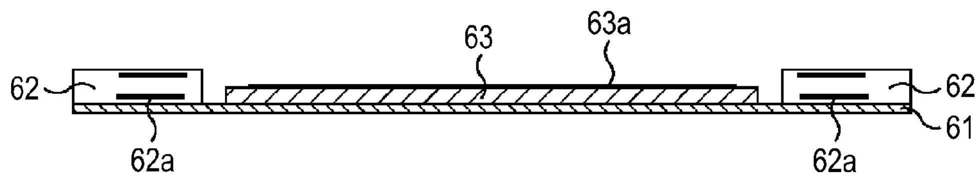


FIG.4D

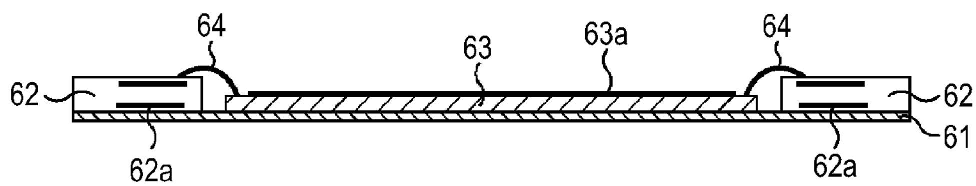
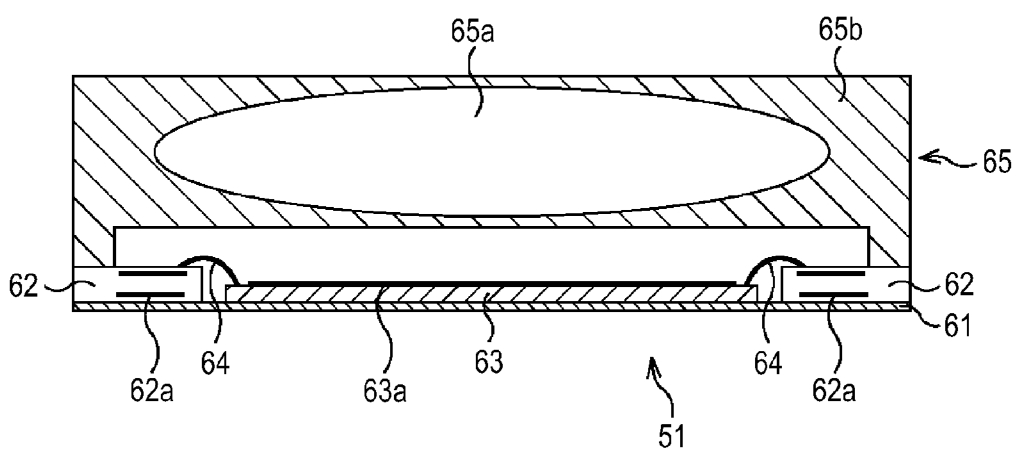


FIG.4E



SEMICONDUCTOR PACKAGE, SEMICONDUCTOR DEVICE MANUFACTURING METHOD, AND SOLID-STATE IMAGING DEVICE

FIELD

The present disclosure relates to a semiconductor package, a semiconductor device manufacturing method, and a solid-state imaging device. More, particularly, the present disclosure relates to a semiconductor package, a semiconductor device manufacturing method, and a solid-state imaging device which make it possible to provide a module having a smaller thickness.

BACKGROUND

According to the related art, an image sensor is packaged by securing it on a substrate through die bonding, and substrates used for such a purpose include substrates in the form of flat plates and substrates formed such that a cavity is provided above a light receiving surface of an image sensor (for example, see JP-A-2003-218333 and JP-A-2003-250072 (Patent Documents 1 and 2)). Ceramic substrates, organic substrates (rigid substrates and flexible substrates) are commonly used as substrates as described above.

A substrate forming a part of a package as thus described has the function of supporting an image sensor and the function of bearing wirings for the image sensor. In order to perform the former function, it is desirable for the substrate to have a great thickness from the viewpoint of strength. In order to provide the latter function, a multi-layer structure including two or more layers is commonly used as a wiring layer. The thickness of the substrate increases with the number of layers. Generally speaking, a substrate including a wiring layer having a two-layer structure has a thickness of 0.1 mm or more, and a substrate including a wiring layer having a four-layer structure has a thickness of 0.2 mm or more.

SUMMARY

Demand for image sensor packages having smaller thicknesses is on increase as a result of the recent trend toward lighter and smaller final products in which such packages are to be set.

FIG. **1** is a sectional view of a camera module **11** according to the related art.

The camera module **11** shown in FIG. **1** includes wiring substrate **21**, an image sensor **22**, wires **23**, and a lens unit **24**.

The wiring substrate **21** includes a wiring layer of a multi-layer structure having a plurality of wiring patterns **21***a*, and an image sensor **22** is secured on the wiring substrate **21** through die bonding. The wiring substrate **21** is formed such that a cavity is provided above a light receiving surface **22***a* of the image sensor **22**. The wiring substrate **21** and the image sensor **22** are electrically connected through the wires **23** using wire bonding. The lens unit **24** is formed by a lens **24***a* and a support portion **24***b*, and the support portion **24***b* supports the lens **24***a* above the wiring substrate **21**, the lens **24***a* allowing light to impinge on the light receiving surface **22***a* of the image sensor **22**.

The thickness of such a camera module **11** may be regarded as separated into the thickness of a lens design factor ranging from the light receiving surface **22***a* of the image sensor **22** up to a top surface of the lens unit **24** and the thickness of a package design factor ranging from the light receiving surface **22***a* of the image sensor **22** down to a bottom surface of the wiring substrate **21**.

When the camera module **11** is to be provided with a smaller thickness with the lens design factor or the optical system kept unchanged, the thickness of the package design factor must be reduced.

Then, what is to be examined is the possibility of a reduction in the thickness of the wiring substrate **21**. When the wiring substrate **21** is a ceramic substrate, the wiring substrate **21** is more liable to crack, the smaller the thickness of the substrate. When the wiring substrate **21** is an organic substrate, the wiring substrate **21** is more liable to twist or warp, the smaller the thickness of the substrate.

As thus described, there has been a limit to the reduction in the thickness of a camera module achievable through a reduction in the thickness of a substrate according to the related art used in the module.

Under the circumstance, it is desirable to reduce the thickness of a module.

An embodiment of the present disclosure is directed to a semiconductor package including a sheet-like thin plate on which a semiconductor chip is secured and a substrate including a wiring layer, disposed on the thin plate to extend over a part of a region surrounding the region where the semiconductor chip is secured or over the entire surrounding region, wherein the semiconductor chip and the substrate are electrically connected.

The thin plate may be formed of a metal.

The thin plate may be formed of stainless steel.

The thin plate may be formed of a metal having high thermal conductivity.

The thin plate may be formed by laminating a layer of stainless steel and a layer of a metal having high thermal conductivity.

The thin plate and the substrate may be electrically connected.

Another embodiment of the present disclosure is directed to a method of manufacturing a semiconductor device including: securing a semiconductor chip on a sheet-like thin plate; disposing a substrate including a wiring layer on the thin plate such that the substrate extends over a part of a region surrounding the region where the semiconductor chip is secured or over the entire surrounding region; and electrically connecting the semiconductor chip and the substrate.

Still another embodiment of the present disclosure is directed to a solid-state imaging device including a lens, an image sensor photo-electrically converting light collected by the lens, a sheet-like thin plate on which the image sensor is secured, and a substrate including a wiring layer, disposed on the thin plate to extend over a part of a region surrounding the region where the image sensor is secured or over the entire surrounding region, wherein the image sensor and the wiring substrate are electrically connected.

In one embodiments of the present disclosure, a semiconductor chip is secured on a sheet-like thin plate; a substrate including a wiring layer is disposed on the thin plate such that the substrate extends over a part of a region surrounding the region where the semiconductor chip is secured or over the entire surrounding region; and the semiconductor chip and the substrate are electrically connected.

According to the embodiments of the present disclosure, a module having a small thickness can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of a camera module according to the related art;

FIG. 2 is a sectional view of a camera module to which the present disclosure is applied;

FIG. 3 is a flow chart for explaining a process of manufacturing a camera module; and

FIGS. 4A to 4E are illustrations showing steps for manufacturing a camera module.

DETAILED DESCRIPTION

An embodiment of the present disclosure will now be described with reference to the drawings. The following items will be described in the order listed.

1. Configuration of Camera Module
2. Steps of Manufacturing Camera Module

<1. Configuration of Camera Module>

FIG. **2** is a sectional view of an embodiment of the present disclosure, i.e., a camera module **51** which is a solid-state imaging device to which the present disclosure is applied.

The camera module **51** includes a thin late **61**, a wiring substrate **62**, an image sensor **63**, wires **64**, and a lens unit **65**.

For example, the thin plate **61** is constituted by sheet metal. Specifically, the thin plate **61** is formed of an SUS (steel use stainless) type metal or a metal having high thermal conductivity such as Al or Cu, and the plate has a thickness of about 0.1 mm. The thin plate **61** may be formed of one type of metal as thus described, and the plate may alternatively be formed by laminating an SUS metal and a metal having high thermal conductivity.

The image sensor **63** is secured on the thin plate **61** using die bonding. The wiring substrate **62** is disposed on the thin plate **61** around the region where the image sensor **63** is secured, and the substrate is secured to the plate so as to surround the image sensor **63**. The wiring substrate **62** includes a wiring layer having a multi-layer structure, the wiring layer including a plurality of wiring patterns **62***a*. The wiring substrate **62** may be disposed throughout the region of the thin plate **61** surrounding the region where the image sensor **63** is secured, and the substrate may alternatively be disposed to cover only a part of the surrounding region.

The image sensor **63** has a light receiving surface **63***a* in which unit pixels each including a photoelectric conversion element (the unit pixels may hereinafter be simply referred to as "pixels") are two-dimensionally arranged in the form of a matrix. The sensor detects the amount of electrical charge as a physical quantity generated at each pixel in accordance with the quantity of light incident on the light receiving surface **63***a*. The wiring substrate **62** and the image sensor **63** are electrically connected through the wires **64** using wire bonding.

The lens unit **65** is formed by a lens **65***a* and a support portion **65***b*, and the support portion **65***b* supports the lens **65***a* above the wiring substrate **62**, the lens **65***a* allowing light to impinge on the light receiving surface **63***a* of the image sensor **63**.

In such a camera module **51**, the range from the light receiving surface **63***a* of the image sensor up to the top surface of the lens unit **65** constitutes a lens design factor, and the range from the light receiving surface **63***a* of the image sensor **63** down to the bottom surface of the thin plate **61** constitutes a package design factor, i.e., an image sensor package.

<2. Steps of Manufacturing Camera Module>

Steps for manufacturing a camera module **51** will now be described with reference to FIG. **3** and FIGS. **4**A to **4**E. FIG. **3** is a flow chart for explaining a flow of a process of manufacturing a camera module **51**, and FIGS. **4**A to **4**E are illustrations showing steps for manufacturing the camera module **51**.

At step S**11**, a thin plate **61** is provided as shown in FIG. **4**A.

At step S**12**, a wiring substrate **62** is connected to the thin plate **61** as shown in FIG. **4**B. At this time, the thin plate **61** and the wiring substrate **62** may be electrically connected after grounding the thin plate **61**. Thus, the electrical characteristics and shielding performance of the wiring substrate **62** can be improved.

At step S**13**, an image sensor **63** is secured on the thin plate **61** using die bonding as shown in FIG. **4**C.

The bonding material used for die bonding may be either material having insulating properties or conductive material. For example, when a material having insulating properties is used as the bonding material, insulation can be established between the thin plate **61** and a silicon substrate of the image sensor **63**. When wire bonding is carried out using a conductive material as the bonding material after grounding the thin plate **61**, the silicon substrate of the image sensor **63** may be grounded. Either material having insulating properties or conductive material may be used as the bonding material for die bonding depending on the characteristics of the image sensor **63** as thus described.

At step s**14**, the wiring substrate **62** and the image sensor **63** are electrically connected through wires **64** using wire bonding, as shown in FIG. **4**D. Bonding methods other than wire bonding may be used as long as the wiring substrate **62** and the image sensor **63** are connected.

At step S**15**, a lens unit **65** is placed on the wiring substrate **62**. Thus, a camera module **51** is completed.

In the configuration and process described above, the image sensor **63** is secured on the thin plate **61** having no wiring layer, and the wiring substrate **62** including a wiring layer is disposed around the image sensor **63**. An image sensor package formed as thus described can be provided with a thickness which is smaller by an amount equivalent to the thickness of the wiring layer compared to the thickness of a package having an ordinary configuration according to the related art in which an image sensor is secured on a wiring substrate including a wiring layer. Consequently, a camera module having a small thickness can be provided.

Since the thin plate **61** is formed of a metal, the strength of the image sensor package can be sufficiently kept even if the package is provided with a small thickness.

Further, when the thin plate **61** is formed of an SUS type metal, an image sensor package having high rigidity can be provided without performing a rust-preventing process.

When the thin plate **61** is formed of a metal having high thermal conductivity such as Al or Cu, it is possible to provide an image sensor package which allows heat released by the image sensor **63** to be efficiently released from the bottom surface of the image sensor **63** to the outside through the thin plate **61**.

Further, when the thin plate **61** is formed by laminating a layer of an SUS type metal and a layer of a metal having high thermal conductivity such as Al or Cu, an image sensor package having the above-described two advantages can be provided.

Since the thin plate **61** and the wiring substrate **62** are provided as separate elements, the thin plate **61** and the wiring substrate **62** can be formed using materials having characteristics appropriate for the respective purposes of the elements. Specifically, characteristics desirable for the wiring substrate **62** can be obtained by using a substrate according to the related art such as a ceramic substrate or organic substrate as the wiring substrate. The thin plate **61** may be made of a material which provides high strength or rigidity even if it has a small thickness. Thus, the plate can be provided with strength or rigidity at a level hard to achieve with a ceramic material or organic material which is optimal as the material of the wiring substrate.

According to the above description, the thin plate **61** is formed of a metal. Alternatively, the plate may be formed of a non-metal material as long as sufficient strength or rigidity can be obtained.

While an exemplary application of the present disclosure to an image sensor package has been described, the present disclosure may be applied to a semiconductor package formed by packaging a predetermined semiconductor chip. Specifically, the present disclosure allows a semiconductor package to be provided with a small thickness, which consequently makes it possible to provide a semiconductor device (semiconductor module) including such a semiconductor package with a small thickness.

The present disclosure is not limited to the above-described embodiment, and various modifications may be made without departing from the spirit of the present disclosure.

The present disclosure may be implemented as the configurations described below.

(1) A semiconductor package including:

a sheet-like thin plate on which a semiconductor chip is secured; and

a substrate including a wiring layer, disposed on the thin plate to extend over a part of a region surrounding the region where the semiconductor chip is secured or over the entire surrounding region, wherein

the semiconductor chip and the substrate are electrically connected.

(2) The semiconductor package according to the item (1), wherein the thin plate may be formed of a metal.

(3) The semiconductor package according to the item (2), wherein the thin plate may be formed of stainless steel.

(4) The semiconductor package according to the item (2), wherein the thin plate may be formed of a metal having high thermal conductivity.

(5) The semiconductor package according to the item (2), wherein the thin plate may be formed by laminating a layer of stainless steel and a layer of a metal having high thermal conductivity.

(6) The semiconductor package according to any of the items (2) to (5), wherein the thin plate and the substrate may be electrically connected.

(7) A method of manufacturing a semiconductor device including:

securing a semiconductor chip on a sheet-like thin plate;

disposing a substrate including a wiring layer on the thin plate such that the substrate extends over a part of a region surrounding the region where the semiconductor chip is secured or over the entire surrounding region; and

electrically connecting the semiconductor chip and the wiring substrate.

(8) A solid-state imaging device including:

a lens;

an image sensor photo-electrically converting light collected by the lens;

a sheet-like thin plate on which the image sensor is secured; and

a substrate including a wiring layer, disposed on the thin plate to extend over a part of a region surrounding the region where the image sensor is secured or over the entire surrounding region, wherein

the image sensor and the wiring substrate are electrically connected.

The present disclosure contains subject matter related to that disclosed in Japanese Priority Patent Application JP 2011-105993 filed in the Japan Patent Office on May 11, 2011, the entire content of which is hereby incorporated by reference.

It should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alterations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

What is claimed is:

1. A semiconductor package comprising:

a flat sheet-like thin plate made of sheet metal having a uniformly flat surface on which a semiconductor chip is secured; and

a multilayer wiring substrate having a plurality of wiring patterns, wherein the plurality of wiring patterns include a plurality of wiring layers formed within the multilayer wiring substrate, wherein the multilayer wiring substrate is disposed on the uniformly flat surface of the thin plate to extend:

over a part of a first region surrounding a second region where the semiconductor chip is secured or

over the entire first region,

wherein the semiconductor chip and the multilayer wiring substrate are electrically connected, and

wherein the multilayer wiring substrate is disposed on the flat sheet-like thin plate in such a manner that the multilayer wiring substrate does not extend beyond the flat sheet-like thin plate.

2. The semiconductor package according to claim **1**, wherein the flat sheet-like thin plate is formed of stainless steel.

3. The semiconductor package according to claim **1**, wherein the flat sheet-like thin plate and the multilayer wiring substrate are electrically connected.

4. The semiconductor package according to claim **1**, wherein at least some portions of the plurality of wiring patterns are surrounded by the multilayer wiring substrate.

5. The semiconductor package according to claim **1**, wherein the semiconductor chip is an image sensor having a plurality of pixels.

6. The semiconductor package according to claim **1**, wherein the semiconductor chip is secured on the uniformly flat surface of the flat sheet-like thin plate using die bonding, wherein a bonding material used for die bonding is a material having insulating properties.

7. The semiconductor package according to claim **1**, wherein the semiconductor chip is secured on the uniformly flat surface of the flat sheet-like thin plate using die bonding, wherein a bonding material used for die bonding is a conductive material.

8. The semiconductor package according to claim **1**, wherein the flat sheet-like thin plate has a thickness of about 0.1 mm.

9. A method of manufacturing a semiconductor device comprising:

securing a semiconductor chip on a uniformly flat surface of a flat sheet-like thin plate made of sheet metal;

disposing a multilayer wiring substrate having a plurality of wiring patterns on the uniformly flat surface of the flat sheet-like thin plate such that the multilayer wiring substrate extends:

over a part of a first region surrounding a second region where the semiconductor chip is secured or over the entire first region,

wherein the plurality of wiring patterns include a plurality of wiring layers formed within the multilayer wiring substrate; and

electrically connecting the semiconductor chip and the multilayer wiring substrate, wherein the multilayer wiring substrate is disposed on the flat sheet-like thin plate in such a manner that the multilayer wiring substrate does not extend beyond the flat sheet-like thin plate.

10. The method according to claim **9**, wherein the semiconductor chip is connected to a ground potential when being connected to the flat sheet-like thin plate.

11. The method according to claim **9**, wherein the flat sheet-like thin plate and the wiring substrate are electrically connected when the flat sheet-like thin plate is connected to a ground potential.

12. A semiconductor package comprising:

a flat sheet-like thin plate made of sheet metal having a uniformly flat surface on which a semiconductor chip is secured; and

a multilayer wiring substrate having a plurality of wiring patterns, wherein the plurality of wiring patterns include a plurality of wiring layers formed within the multilayer wiring substrate, wherein the multilayer wiring substrate is disposed on the uniformly flat surface of the thin plate to extend:

over an entire first region surrounding a second region where the semiconductor chip is secured,

wherein the semiconductor chip and the multilayer wiring substrate are electrically connected, and

wherein the multilayer wiring substrate is disposed on the flat sheet-like thin plate in such a manner that the multilayer wiring substrate does not extend beyond the flat sheet-like thin plate.

* * * * *